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WEATHER AND CIRCULATION OF MARCH 1971

Drought Becomes a Major Concern in the Southwest and in Southern Florida

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1. MEAN CIRCULATION

Blocking over North America was a primary feature of the 700-mb circulation for March 1971 (figs. 1 and 2). Two centers of blocking action were in evidence as one High was observed in the Beaufort Sea area with an attendant Low over southern Alaska while another High occurred in eastern Canada with a Low to the southeast. The North American anticyclones apparently developed at the expense of the intense block that had been located over northern Siberia during February (Wagner 1971).

Negative height anomalies of up to 210 m occurred near the Taymyr Peninsula (fig. 3) as the blocking of February was replaced by a weak Low. The return to a more normal flow pattern over eastern Asia was accompanied by a trough near its normal position off the Asiatic coast with a Low near Kamchatka where heights were up to 60 m lower than normal (fig. 2).

The 700-mb pattern across the Pacific was zonal with negative height departures in the north and positive in the south. This was in sharp contrast to the amplified picture of the previous month. Heights increased by more than

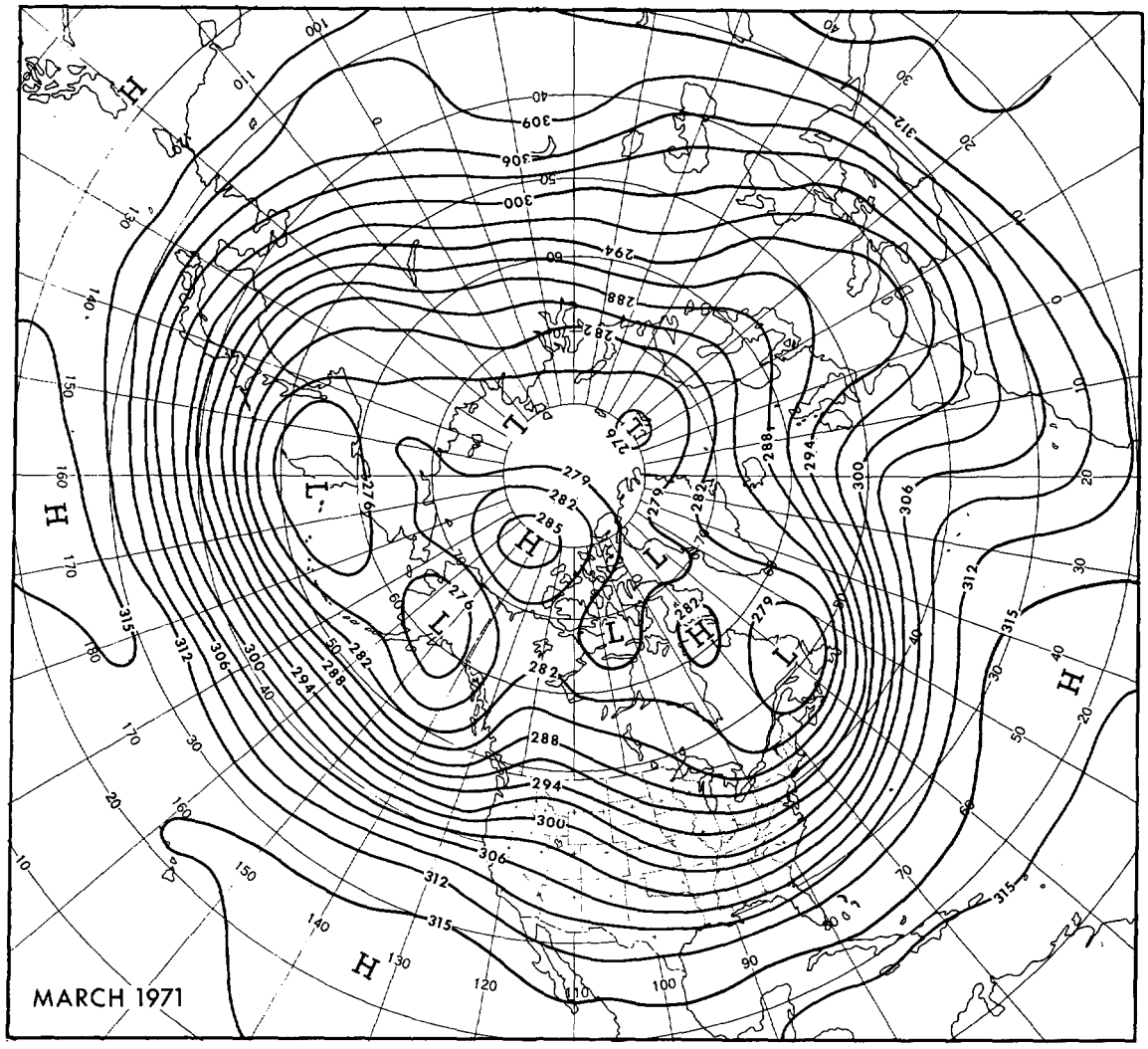


FIGURE 1.—Mean 700-mb contours (dekameters) for March 1971.

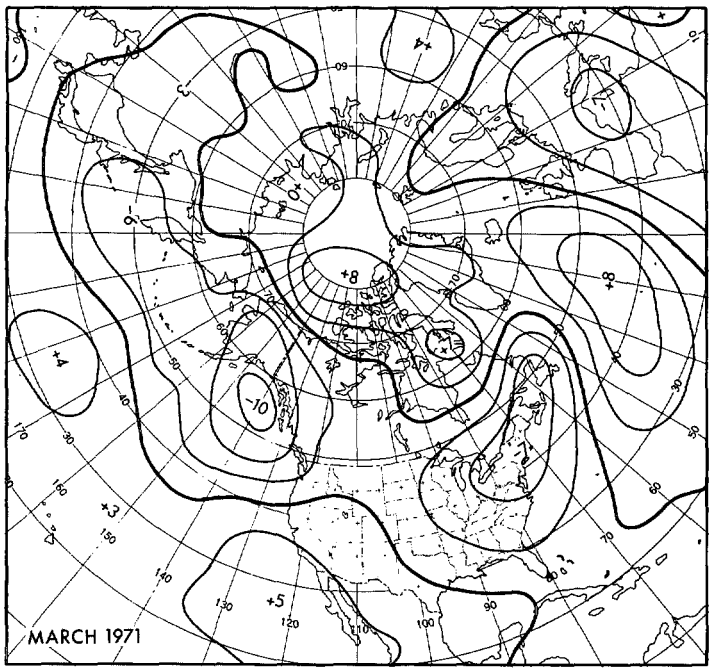


FIGURE 2.—Departure from normal of mean 700-mb height (dekameters) for March 1971.

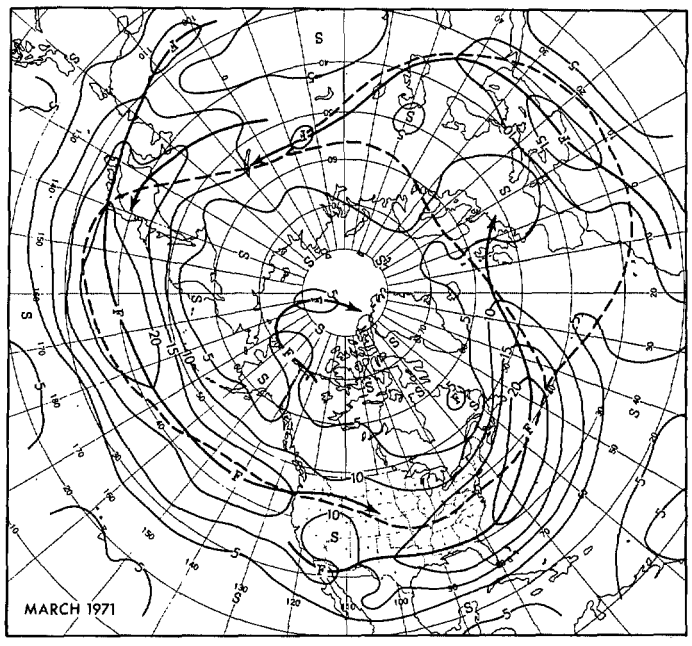


FIGURE 4.—Mean 700-mb isotachs (m/s) for March 1971. Heavy lines show the principal observed axes of maximum wind speed, and the dashed lines show the normal.

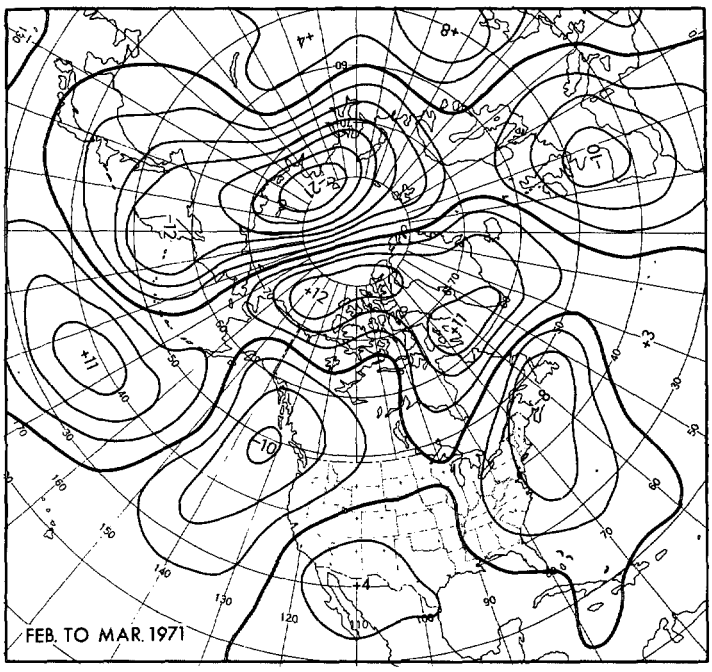


FIGURE 3.—Mean 700-mb height anomaly change (dekameters) from February to March 1971.

100 m in the central Pacific as a weak ridge replaced the deep trough of February. Falls of like magnitude occurred off the west coast of North America as the Gulf of Alaska Low developed in conjunction with the Arctic block. Although the axis of the maximum wind speed over the Pacific was not substantially displaced from its normal position (fig. 4), the mid-latitude westerlies were 4 to 8 m/s stronger than normal over the area.

Over the United States, the 700-mb wave train was forced eastward as a trough became established in the eastern Pacific. The ridge in the West moved eastward and weakened, but the trough that had been located over the Mississippi Valley region during February strengthened along the Eastern Seaboard as a Low developed to the southeast of the eastern Canadian block. Heights were 70 m above normal in the High in eastern Canada while they were 70 m below normal directly to the south over New England. Westerly winds through the trough were 5 to 10 m/s faster than normal in a band near the jet axis from the gulf coast into the north-central Atlantic.

A strong full-latitude ridge was observed over the eastern Atlantic. This ridge was a combination of retrogression from its February position, in response to deepening of the trough upstream, and general height rises in northern latitudes. As the ridge moved westward, upper level heights over most of Europe fell with respect to normal as a trough strengthened southward from Scandinavia. The trough was deepest over the Mediterranean Sea where 700-mb heights were as much as 70 m below normal.

2. MONTHLY TEMPERATURE

Mean surface temperatures over the United States during March 1971 were generally below normal over the East and above in the West (fig. 5), continuing the basic pattern of the past few months. Compared with February (Wagner 1971), temperatures were higher than

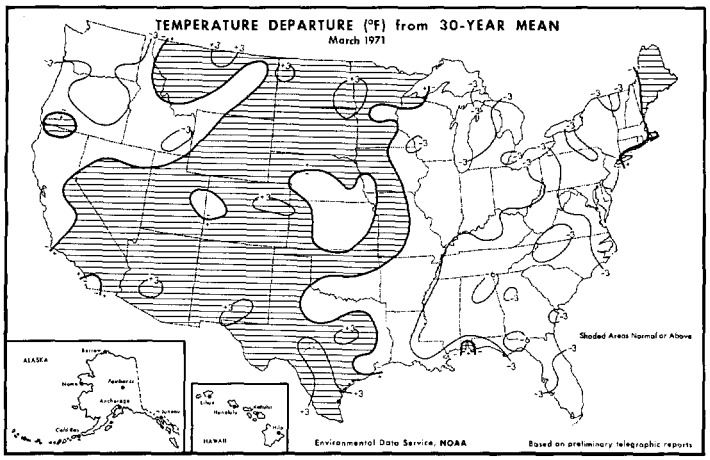


FIGURE 5.—Departure from normal of average surface temperature (°F) for March 1971 (from Environmental Data Service and Statistical Reporting Service 1971).

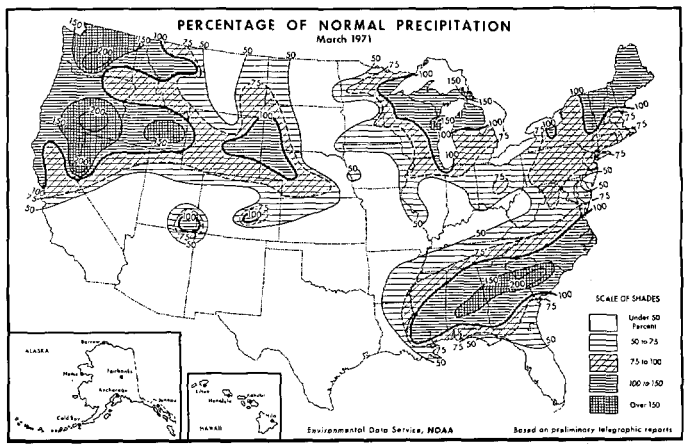


FIGURE 6.—Percentage of normal precipitation for March 1971 (from Environmental Data Service and Statistical Reporting Service 1971).

TABLE 1.—*Temperature records established during March 1971*

Station	Temperature (°F)	Date	Remarks
Boise, Idaho	6	1	Lowest Mar. min. since 1906
Sexton Summit, Oreg.	15	1	Lowest Mar. min. on record
Santa Maria, Calif.	24	2	Lowest Mar. min. on record
Tallahassee, Fla.	23	5	Tied lowest Mar. min. on record
Wendover, Utah	13	6	Tied lowest Mar. min. on record
Nome, Alaska	−46	11	Lowest Mar. min. on record
" "			2d lowest min. for any month
King Salmon, Alaska	−42	13	Lowest min. on record for any month
St. Paul Island, Alaska	−19	14	2d lowest min. for any month
Corpus Christi, Tex.	97	25	Highest Mar. max. on record
Albuquerque, N. Mex.	85	26	Highest Mar. max. on record
Colorado Springs, Colo.	81	26	Highest Mar. max. on record
Roswell, N. Mex.	95	27	Tied highest Mar. max.
Austin, Tex.	98	28	Highest Mar. max. on record
San Antonio, Tex.	100	28	Highest Mar. max. on record
Waco, Tex.	100	28	Highest Mar. max. on record
Phoenix, Ariz.	95	29	Tied highest Mar. max.

TABLE 2.—*Record and near-record monthly precipitation totals for March 1971*

Station	Total (in.)	Departure (in.)	Remarks
Nome, Alaska	T	−0.88	Tied driest Mar. on record
Tucson, Ariz.	T	− .53	Tied 2d driest Mar. on record
Grand Junction, Colo.	0.02	− .73	Tied driest Mar. on record
Key West, Fla.	T	−1.77	Tied driest Mar. on record
Ely, Nev.	0.20	−0.65	3d driest Mar. on record
" "	−	−	89% sunshine—highest Mar. on record
Oklahoma City, Okla.	0.07	−1.90	3d driest Mar. on record
Tulsa, Okla.	.08	−2.35	Driest Mar. on record
Aberdeen, S. Dak.	.04	−1.05	Driest Mar. on record
Brownsville, Tex.	T	−1.04	Tied driest Mar. on record
Corpus Christi, Tex.	T	−1.44	2d driest Mar. on record
Dallas, Tex.	0.28	−2.57	2d driest Mar. on record
El Paso, Tex.	.00	−0.35	Tied driest Mar. on record
" " "	−	−	99% sunshine—highest Mar. on record
Lakeview, Oreg.	3.84	+2.32	3d wettest Mar. on record
Columbia, S.C.	9.53	+5.27	Wettest Mar. on record
Olympia, Wash.	9.11	+3.71	2d wettest Mar. on record
Seattle, Wash. (CO)	7.16	+3.84	2d wettest Mar. on record

normal over the Great Plains and lower over the East, in response to the eastward movement of the 700-mb features. Temperatures were also lower than normal in the Northwest as cool Pacific air dominated the area.

The mean departures were not excessive as only two small 6°F isolines were needed, both in the colder than normal Southeast; but the cold in the Northwest was persistent. At Pendleton, Oreg., the daily maxima failed to reach 60°F during March for the first time at the present location established in 1935.

Notable monthly mean temperature records were lacking, but weather variations throughout the month brought record extreme maxima and minima temperatures for the month to numerous stations scattered throughout the country (table 1).

This March was one of the coldest on record at many locations throughout Alaska as temperatures averaged below normal over the entire State. Mean departures over much of the southwestern quarter of Alaska exceeded −10°F. This was the result of an extremely cold first 2 weeks of March as 700-mb heights averaged up to 200 m below normal over the State. King Salmon reported −42°F on the 13th, its coldest minimum on record for any month. Alaskan temperatures moderated during the second half of the month as heights rose due to blocking.

3. MONTHLY PRECIPITATION

Precipitation in March was below normal over a large part of the Nation (fig. 6), in sharp contrast to the relatively heavy amounts of February (Wagner 1971). Reports of record and near-record March dryness were common (table 2) as extensive areas of the Southwest, Great Plains, Ohio Valley, and Florida received less than half the usual monthly amounts.

A large area from southern Nevada and California to Texas had only a trace of precipitation at most. There and

TABLE 3.—*Record and near-record monthly and seasonal snowfall for March 1971*

Station	Total (in.)	Remarks
Portland, Maine	132.3	Greatest seasonal snowfall on record
Houghton Lake, Mich.	28.7	Greatest Mar. snowfall since 1942
" " "	120.6	Greatest seasonal snowfall to date
Muskegon, Mich.	29.0	2d greatest Mar. snowfall on record
Binghamton, N.Y.	33.5	Greatest Mar. snowfall on record
Rochester, N.Y.	141.5	Tied 2d greatest seasonal snowfall
Medford, Oreg.	5.0	2d greatest Mar. snowfall on record
" "	5.0	Greatest snowfall for any Mar. calendar day on 16th
Erie, Pa.	26.7	2d greatest Mar. snowfall on record
" "	117.0	Greatest seasonal snowfall on record
Rapid City, S. Dak.	62.7	Greatest seasonal snowfall to end of March
Yakima, Wash.	10.8	Greatest Mar. snowfall on record
Elkins, W. Va.	33.0	Greatest Mar. snowfall on record
" " "	102.4	Greatest seasonal snowfall on record

in southern Florida, drought was becoming a major concern as the March dryness was a continuation of a longer period trend. The period from November 1970 through March 1971 was the driest 5-mo period ever recorded at San Antonio, Tex., as only 1.05 in. of rain fell. At Roswell, N. Mex., it was the eighth consecutive month with deficient precipitation while in Florida it was the ninth straight at West Palm Beach and the 10th at Fort Myers.

In contrast to the generally dry conditions elsewhere, parts of the Northwest and Southeast had more than twice the normal March precipitation. Most of the excessive precipitation fell as snow (table 3); and this combined with the snowfall of previous months already brought seasonal totals to record levels, particularly around the Great Lakes and in the Northeast.

In Alaska, most agricultural areas received less than the usual March totals, with Nome equaling its March low with only a trace.

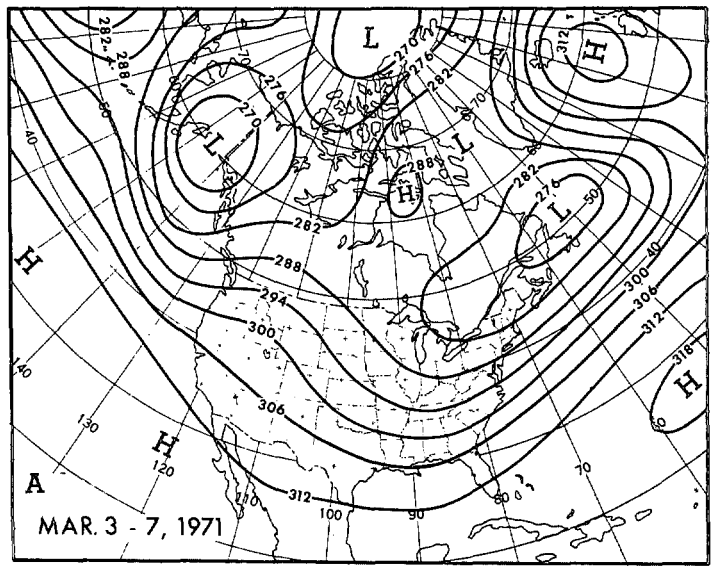
4. WEEKLY WEATHER

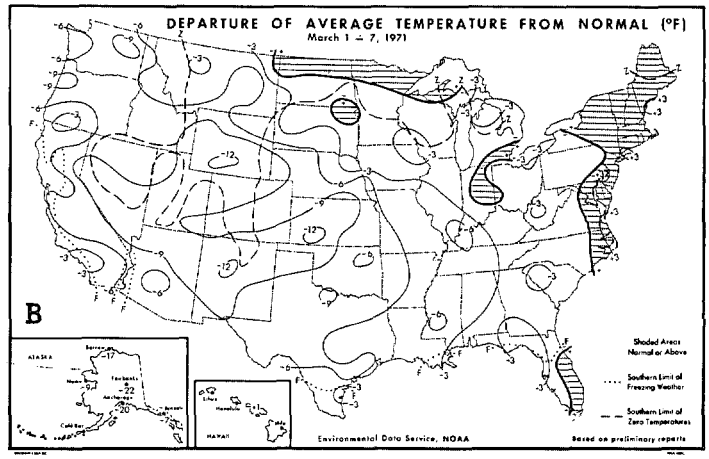
MARCH 1–7, 1971

The trough that had become established over the West in the last week of February (Wagner 1971) moved eastward during the first week of March, bringing below-normal temperatures to most of the Nation (figs. 7A and 7B). Much of the West averaged more than 6°F below normal, and the southern limit of zero temperatures extended into the Central Rockies.

Rainfall amounts of more than 2 in. fell over the Far Northwest and the Northeast; and in the Southeast, weekly totals exceeded 4 in. from southern Mississippi to the Carolinas. No precipitation occurred over much of the Southwest from California to Texas and in parts of the Northern and Central Plains.

Heavy rains began falling over the Southeast early in the week, causing some flash flooding in lowland areas. Overrunning combined with easterly surface winds north





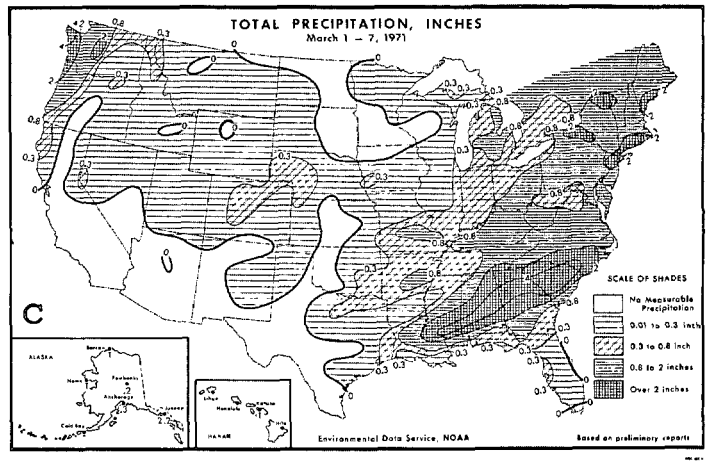


FIGURE 7.—(A) mean 700-mb contours (dekameters) for Mar. 3–7, 1971; (B) departure from normal of average surface temperature (°F) and (C) total precipitation (in.) for the week of Mar. 1–7, 1971 (from Environmental Data Service and Statistical Reporting Service 1971).

of a stationary front brought 24-hr rainfall totals in excess of 4 in. to parts of Mississippi and Alabama.

Early on the 3d, a weak Low in the Southeast began to deepen rapidly and move northeastward. On the next day,

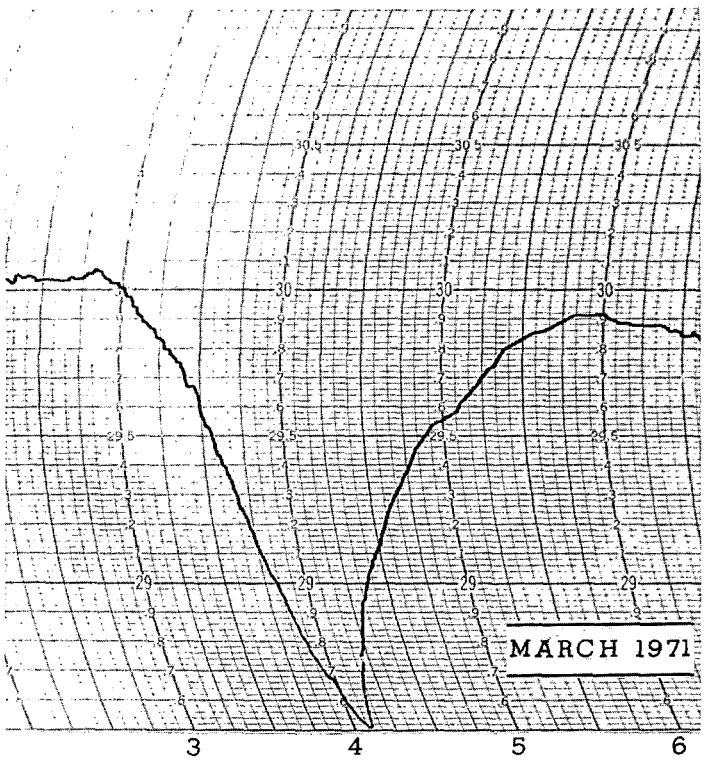


FIGURE 8.—Barograph trace recorded at Newton, Mass., showing the hurricanelike pressure pattern associated with the storm of Mar. 4, 1971 (trace was furnished by Donald A. Rosenfeld of Newton, Mass.).

this deep storm was pounding the Northeast with damaging wind gusts of up to 80 mi/hr and dropping 1 to 2 ft of snow over the area. Heavy drifting accompanying the storm caused many schools and businesses to close, particularly those in New York and Pennsylvania.

As the storm passed near Concord, N.H., on the 4th, the station recorded a sea-level pressure of 28.44 in. of mercury, the lowest ever observed there. At Boston, Mass., a 28.47-in. reading was the second lowest in nearly 100 yr of record. A barograph trace of the storm (fig. 8) taken at Newton, Mass., shows a hurricanelike pattern. Pressure began falling about noon on the 3d, reached a minimum shortly after noon on the 4th, and reached a maximum again on the 6th.

A satellite view of the storm is shown in figure 9. At this time, the storm center was in the area of southern Maine. The bright cloud shield is typical of a mature cyclone, but it is of interest to note the rapid clearing behind the cold front in the area to the east of Cape Cod.

By the end of the week, snow was falling over the Great Lakes and into the Northeast as a new deep Low moved northeastward across the lakes and an accompanying cold front pushed strongly through the East.

MARCH 8–14, 1971

The mean 700-mb pattern over the United States during this period (fig. 10A) had considerably less amplitude than that of the previous week. The stationary ridge over the West flattened as a weak lee trough developed over the Great Plains States, forcing the trough over the East to progress to a position off the coast.

The resultant temperature pattern (fig. 10B) had positive anomalies over most of the country, with the greatest warmth over the Great Plains where temperatures generally averaged more than 6°F above normal. In contrast, departures were negative over the Far West, Northeast, and Southeast.

Weekly precipitation totals of more than 2 in. were limited to the West Coast States and to the Lower Mississippi Valley region. No measurable precipitation was observed over a large area of the Southwest and the Central and Southern Plains States. Extreme southern Florida and a portion of the Middle Atlantic States were also dry.

Heavy thunderstorms broke out in Arkansas and Louisiana on the 9th as a cold front moved through the area. At De Ridder, La., the winds gusted to 100 mi/hr. Rain and snow spread over much of the East as the front moved rapidly to the Atlantic and a Low passed over the Northeast.

A strong system moved into the West after midweek, causing heavy rains along the coast with some locally high precipitation intensities noted in California. This system brought snow to the northern Rockies and Great Plains; and Lander, Wyo., reported a wind gust of 84 mi/hr on the 13th as the front passed. As this system moved eastward into the Great Plains, strong warming developed ahead of the front. Maximum temperatures of at least 80°F were reported at the end of the week from the Central Plains southward to Texas. At McAllen, Tex., the thermometer registered 101°F on the 14th.

Severe weather accompanied a squall line that moved eastward from Oklahoma after midweek. Several tornadoes struck south-central Oklahoma on the 12th, damaging or destroying about 40 dwellings. Heavy thunderstorms with hail and damaging winds were reported in Tennessee, and Texas also had some hail. Some record low temperatures were recorded in Alaska during this period (table 1) as the mean 700-mb heights reached 270 m below normal.

MARCH 15–21, 1971

A strong 700-mb ridge developed off the west coast of the United States this week (fig. 11A) as heights rose to 130 m above normal west of Vancouver. This ridge connected northward to a strong block over the Canadian Arctic. Meanwhile, a trough was reestablished over the eastern United States as heights were as much as 100 m lower than normal.

Temperature anomalies for the period (fig. 11B) were generally cooler than the previous week as the northwesterly flow aloft brought cold Canadian air into the country. However, temperatures did rise over the Far

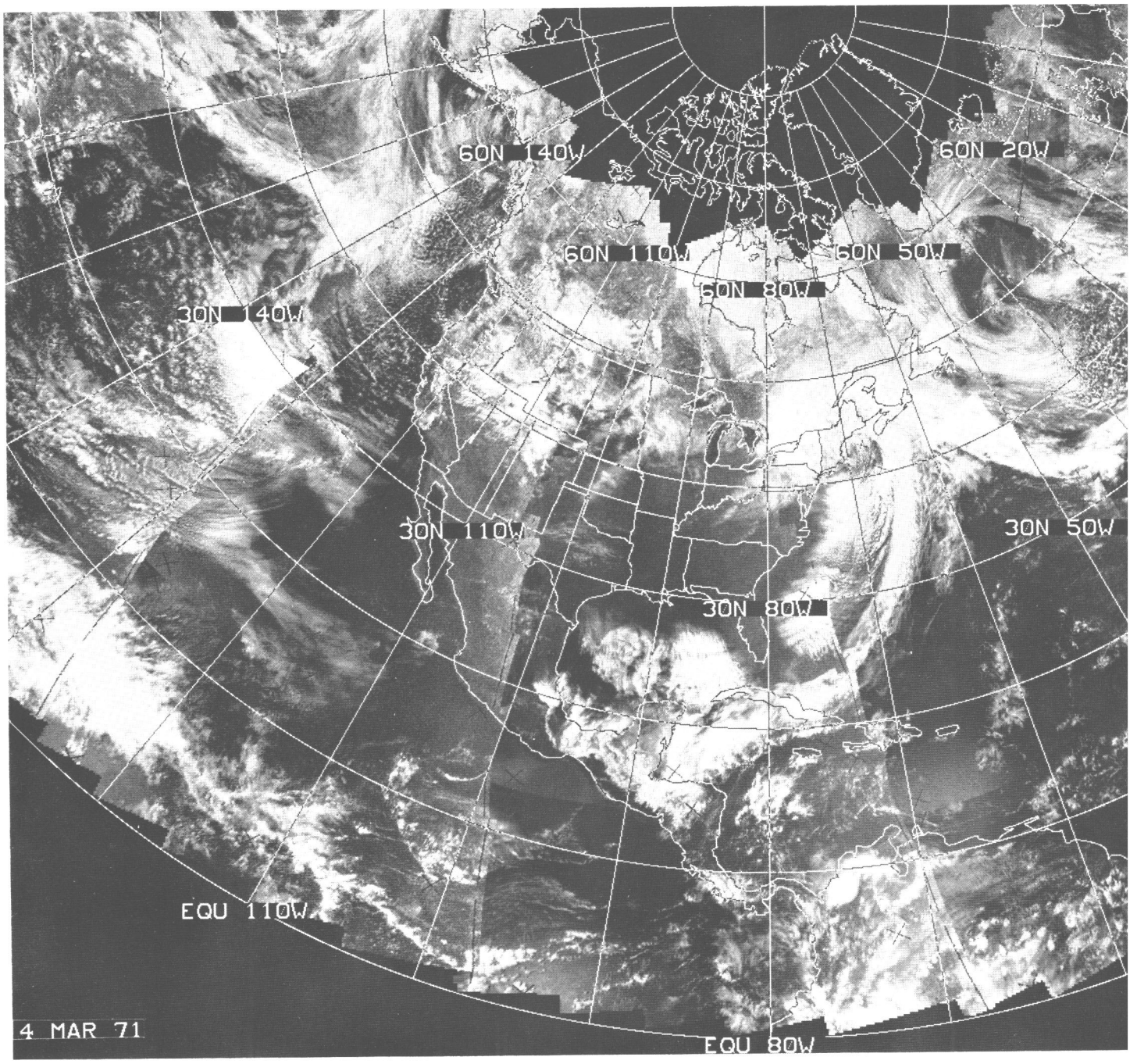


FIGURE 9.—Cloud distribution over the North American sector as photographed by ITOS 1 satellite at 2147 GMT on Mar. 4, 1971.

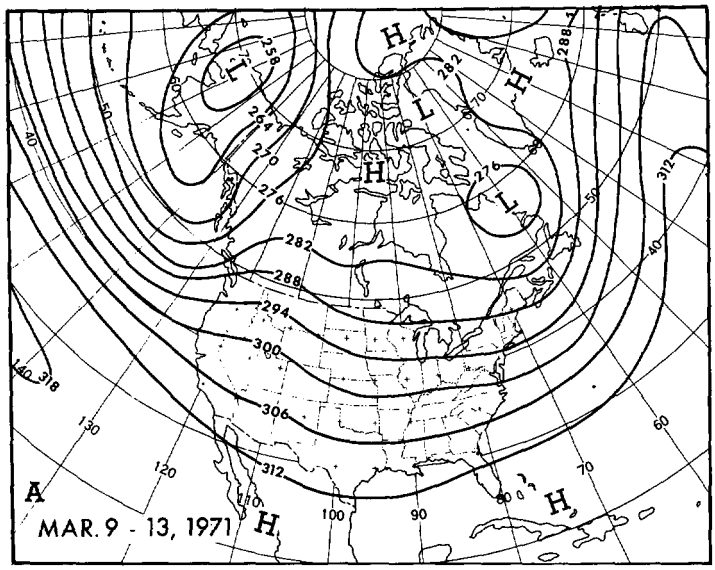
Southwest, in response to above normal 700-mb heights. Warming also occurred in the Northeast.

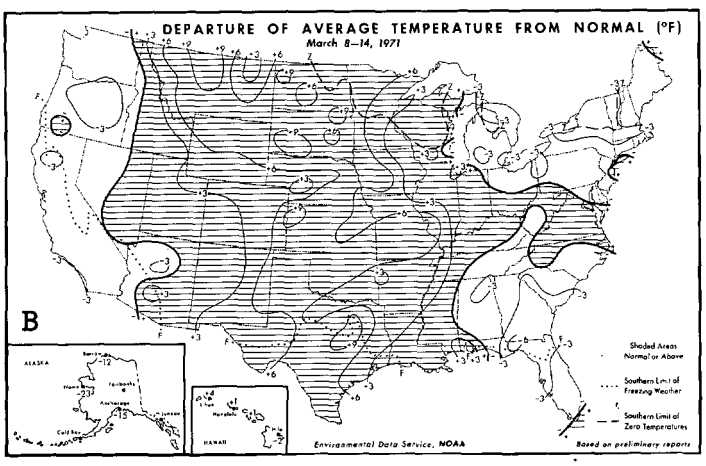
Total precipitation over the Nation during this week exceeded 2 in. only in several small areas near the gulf coast (fig. 11C). Most of the southwestern quarter of the country had no measurable precipitation at all and neither did an elongated area in the Northwest.

A deepening Low moved out of the Central Plains toward the Great Lakes as the week started. Some heavy snow fell along its path; and as its cold front moved rapidly eastward, it triggered damaging winds and a few tornadoes in the Ohio Valley.

On the 18th, an intense system was bringing heavy snow and strong winds to the Central Plains area as blizzard conditions were reported in Kansas and Nebraska. Considerable blowing dust was raised in Kansas as winds gusted to 115 mi/hr at Hays, where for 3 consecutive hours the wind speed did not drop below 65 mi/hr. Concordia, Kans., registered a fastest mile wind speed of 68 mi/hr., the highest on record there. The storm left 6 to 15 in. of snow in its wake as it made its way through the Great Lakes region and into New England.

Cold air pushed in behind the storm, bringing freezing temperatures southward into Florida. Record low minima





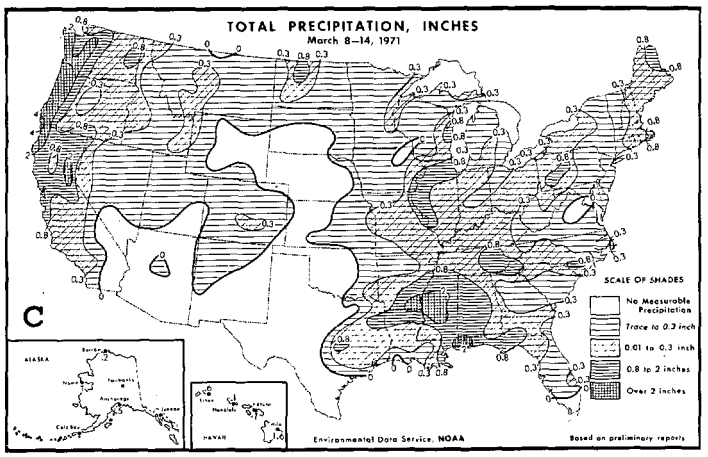
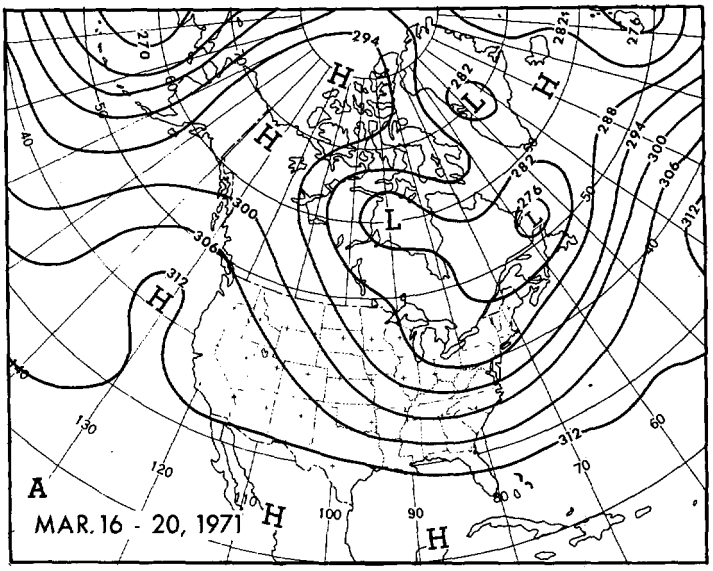
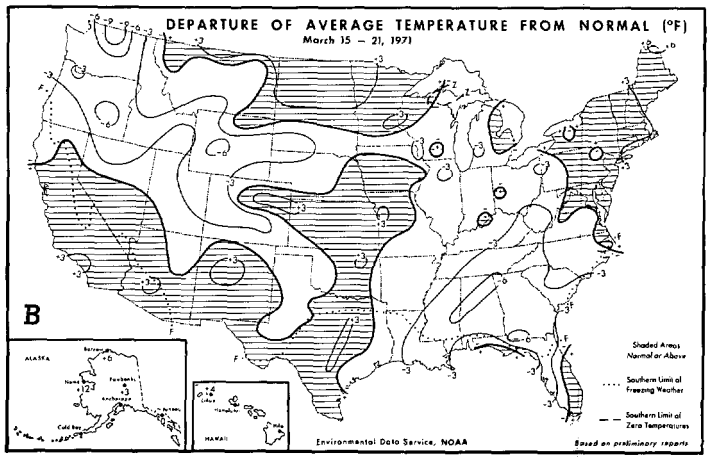


FIGURE 10.—Same as figure 7, (A) for Mar. 9–13, 1971; (B) and (C) for Mar. 8–14, 1971.





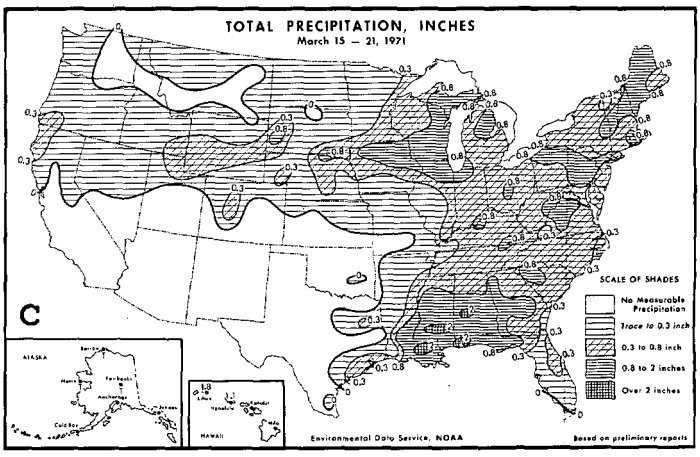


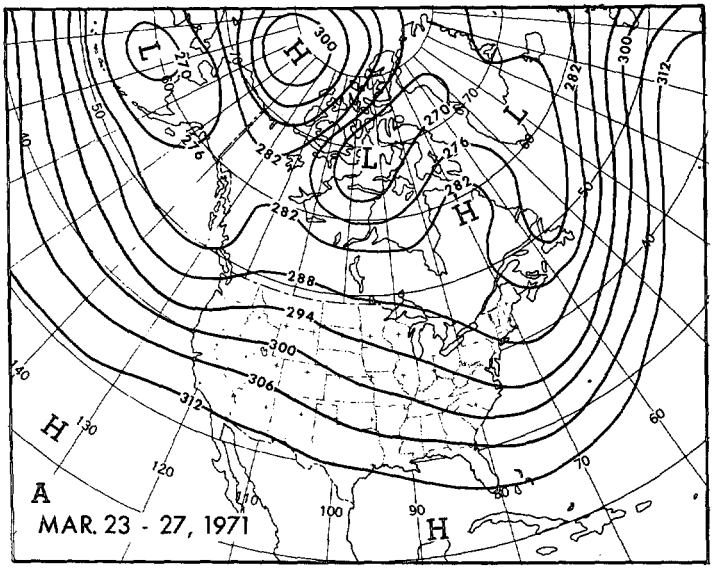
FIGURE 11.—Same as figure 7, (A) for Mar. 16–20, 1971; (B) and (C) for Mar. 15–21, 1971.

for so late in the season were reported on the 21st at Tallahassee (26°F), Jacksonville (30°F), and Tampa (35°F).

MARCH 22–28, 1971

The mean 700-mb flow this period over the United States (fig. 12A) was similar to that of the second week of March. The strong ridge of the past week weakened considerably as it moved eastward to the Rockies while the trough over the East remained strong as it progressed to a position off the coast.

Mean surface temperatures for the week (fig. 12B) were generally below normal from the Great Plains eastward, with above normal to the west. Temperatures over most of the East were more than 6°F lower than normal



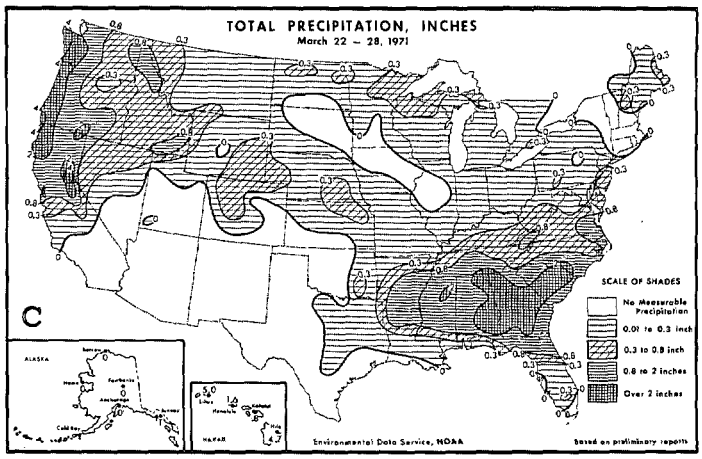
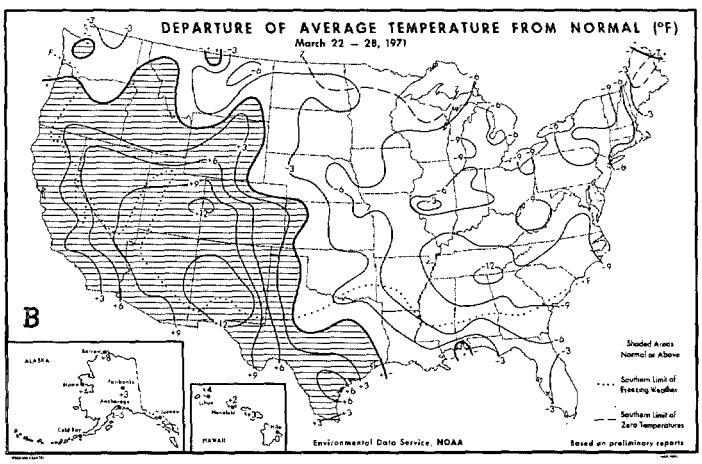


FIGURE 12.—Same as figure 7, (A) for Mar. 23–27, 1971; (B) and (C) for Mar. 22–28, 1971.



while a large area of the Southwest averaged more than 9°F above normal. Early in the period, cold air covered most of the Nation east of the Rockies after a cold front had pushed southward to the Gulf of Mexico.

More than 4 in. of precipitation occurred in the West Coast States, and a large area of the Southeast received more than 2 in. during the week (fig. 12C). In contrast, much of the Southwest into southern Texas was again dry. An area from the Dakotas to Illinois and another in the Northeast were also without measurable precipitation.

Precipitation accompanied an upper level trough as it moved out of the Rockies and over the Central Plains at midweek. Cheyenne, Wyo., had 8 in. of snow while the Nebraska-Kansas area generally received 5–10 in.

As the trough continued eastward, a Low developed off the Carolina coast. The resulting circulation spread precipitation over the Southeast and Middle Atlantic States, much of it in the form of snow. Snowfall amounts of 5 to 10 in. were common from Georgia to Maryland. This was the heaviest snowfall for so late in the season in areas of Georgia and the Carolinas.

Rapid warming came to the south-central part of the Nation as a temperature of 104°F was recorded at Frederick, Okla., on the 27th. This was the highest temperature ever observed in the State for any March. Record maxima were observed at a number of stations in the Southwest during the week (table 1).

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Wagner, A. James, "Weather and Circulation of February 1971—A Stormy Month With a Marked Mid-Month Reversal in the Temperature Regime," *Monthly Weather Review*, Vol. 99, No. 5, May 1971, pp. 439–446.

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